CLAIMS

1. A rotary actuator comprising:

a stator having plural permanent magnets;

a rotor having a rotor core which two salient poles are formed at, and one or more rotor coils are wound around;

an electro-magnetic torque generating portion comprising the stator and the rotor between which electro-magnetic torque is generated by supplying an electric current to the rotor coils, which, in approximate proportion to the magnitude of the electric current, displaces a relative angle position of the rotor and the stator; and

an elastic member biased in approximate proportion to the magnitude of the relative angle displacement of the rotor and the stator and thereby generating a torque in the direction opposite to the direction of the electro-magnetic torque.

2. A rotary actuator according to claim 1, the actuator further comprising:

an elastic member driving device rotating together with the rotor or the stator when the rotor or the stator rotates in a predetermined rotation direction and thereby biasing the elastic member.

3. A rotary actuator according to claim 1, the actuator further comprising:

a first elastic member driving device rotating together with the rotor or the stator when the rotor or the stator rotates in one direction and thereby biasing an elastic member; and

a second elastic member driving device rotating together with the rotor or the stator when the rotor or the stator rotates in the other direction and thereby biasing the same elastic member.

4. A rotary actuator according to claim 1, the actuator further comprising:

a first elastic member to which electro-magnetic torque is applied when the rotor or the stator rotates in one rotation direction; and

a second elastic member to which electro-magnetic torque is applied when the rotor or the stator rotates in the other rotation direction.

5. A rotary actuator according to claim 4, wherein the first elastic member and the second elastic member have elastic moduli different from each other.

6. A rotary actuator according to claim 1, wherein the elastic member is biased beforehand by applying a preload to the elastic member.

7. A rotary actuator according to claim 1, wherein the actuator is structured such that:

the stator having two permanent magnets;

the rotor core having two salient poles;

the permanent magnet having two circumferential end portions and one circumferential center portion, the radial thickness of the circumferential end portion being from 90% to 95% of the radial thickness of the circumferential center portion;

the distance from the radial outline of the circumferential center portion of the salient pole to the rotation center of the rotor core being not more than 99% of the distance from the radial outline of the circumferential end portion of the salient pole to the rotation center of the rotor core; and

the angle between the line connecting one of circumferential outlines of a salient pole and the rotation center of the rotor core and the line connecting the other circumferential outline of the same salient pole and the rotation center of the rotor core being not less than 100 degrees.

8. A rotary actuator according to claim 1, wherein the actuator is structured such that:

the permanent magnet having two circumferential end portions and one circumferential center portion,

the radial thickness of the permanent magnet at the circumferential end portions being smaller than the radial thickness of the permanent magnet at the circumferential center portion,

the distance from the radial outline of the circumferential center portion of the salient pole to the rotation center of the rotor core being smaller than the distance from

the radial outline of the circumferential end portions of the salient pole to the rotation center of the rotor core, and

the angle between the line connecting one of circumferential outlines of a salient pole and the rotation center of the rotor core and the line connecting the other circumferential outline of the same salient pole and the rotation center of the rotor core being an obtuse angle.

9. A rotary actuator according to claim 1, wherein the rotor core and the permanent magnet have facing surfaces facing each other, the facing surfaces of the rotor core and the permanent magnet formed in the shapes of circular arc surfaces of which center positions are different from each other.

10. A rotary actuator according to claim 1, wherein the permanent magnet has a facing surface facing the rotor core, the facing surface formed in the shape of an elliptical surface.

11. A rotary actuator according to claim 1, wherein the permanent magnet has a facing surface facing the rotor core and has two circumferential end portions, the facing surface at the circumferential end portion formed in the shape of a flat-cut surface.

12. A rotary actuator according to claim 1, wherein the rotor core has two facing surfaces respectively facing the two permanent magnets, each of the facing surfaces of the rotor core formed in the shape of a plurality of circular arc surfaces of which center positions are different from each other.

13. A rotary actuator according to claim 1, wherein the rotor core has two facing surfaces respectively facing the permanent magnets, each of the facing surfaces formed in the shape of an elliptical surface.

14. A rotary actuator according to claim 1, wherein the rotor core has two facing surfaces respectively facing the two permanent magnets, the facing surface at a circumferential end portion of the salient pole formed in the shape of a flat-cut surface.

15. A rotary actuator according to claim 1, wherein the permanent magnet has two circumferential end portions, each of which has a non-magnetized region formed thereat